

INTERNATIONAL LICENSING OPPORTUNITY



The global wind industry is large and growing. While most turbine manufacturers focus on very large wind turbines, Windflow Technology Ltd has positioned itself as *the partner of choice in midsize wind*, offering two differentiated wind turbine products at the 500 kW size. Windflow believes there is tremendous global opportunity for wind turbines of this scale, and is actively seeking manufacturing licensees for our designs and technology in major markets globally.

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WORLD LEADER IN MIDSIZE WIND TURBINES

The bulk of today's global wind turbine market is served by very large machines: 2.5+ MW rated capacity, 100+ tonnes machine head mass, 50+ m blades, 100+ m towers, etc. However, there are many markets where these turbines are simply too large, either in relation to the size of the grid or due to logistics and installation limitations (e.g. lack of infrastructure or crane availability). These markets include islands, remote grids, behind-the-meter applications, and utility-scale power generation in developing, high-growth countries. In these cases, a mid-sized 500 kW wind turbine that is simple to ship and assemble has a significant commercial advantage.

Windflow Technology Ltd has been designing, manufacturing, installing and operating 500 kW turbines to serve these markets for over a decade. Windflow is a New Zealand-based publicly listed (NZX: WTL) designer and manufacturer of IEC certified and CE compliant wind turbines. The company is ISO 9001:2008 certified and has a successful track record of designing, installing and operating wind turbines in challenging wind conditions.

With more than 550 turbine-years operating experience and a fleet-wide average availability of 95%+, Windflow's products have proven their robust design and high reliability in some of the most challenging wind conditions in the world.



WINDFLOW TRACK RECORD

TE RERE HAU

Ninety-seven Windflow 33-500 turbines were installed at the Te Rere Hau windfarm near Palmerston North, New Zealand between 2006 and 2010. This site exhibits some of the most challenging wind conditions in the world, with greater than 10 m/s average annual wind speed. Some of the turbines on site see monthly-average wind speed above 15 m/s. Many of the turbines experience significant hill effects, and extreme turbulence and wind shear. Despite these challenging conditions, the Windflow 33-500 has proven itself by accumulating more than 550 turbine-years of operation at higher than 95% availability.



UNITED KINGDOM

Since 2013, seven Windflow 33-500 turbines and one Windflow 45-500 have been installed in the United Kingdom. Despite the remote locations, all are grid-connected turbines feeding power into the local utility grid. Most of the turbines see complex terrain effects and high turbulence. To date the UK fleet exhibits an average availability greater than 95%.



PROVEN 500 kW WIND TURBINES, IEC CERTIFIED DESIGN

Windflow currently offers two wind turbine products: the proven Windflow 33-500 for high wind speed sites and the recently-developed Windflow 45-500 for medium wind speed sites.

The **Windflow 33-500** wind turbine has been designed for a 20-year life at a Class 1A site in accordance with IEC 61400-1:2005 (Edition 3). It is a robust machine designed for sites with up to 10 m/s average annual wind speed, and storms gusting up to approximately 70 m/s. Independent Type Certification was awarded in September 2010 by Lloyd's Register. The Windflow 33-500 is in serial production, with 104 units installed around the world.

The **Windflow 45-500** has been designed for a 20-year life at a Class 2A site in accordance with IEC 61400-1:2005. It is designed for sites with up to 8.5 m/s average annual wind speed, and storms gusting up to approximately 60 m/s. Prototype Windflow 45-500s have been installed and site commissioned in Texas, USA in early 2015, and Scotland in late 2016..



Windflow 33-500



Windflow 45-500

WINDFLOW PROPRIETARY TECHNOLOGY

Windflow utilizes several cutting-edge technologies to enable lightweight but high-performing and extremely robust wind turbine designs. These include:

- Two-bladed rotor, with Windflow's proprietary **Teeter Control System™**, which combines passive load shedding with improved stability and energy capture
- The patented **Torque Limiting Gearbox™**, which enables the use of a synchronous generator directly on line without the need for expensive and unreliable power electronics
- Windflow's proprietary **Low Variable Speed™** system reduces blade tip noise in low wind conditions and improves energy capture

On all wind turbines turbulence, wind shear, tower shadow, pitch imbalance and yaw error cause an imbalance of loads on the rotor. Three-bladed machines have no simple means of mitigating these loads, and without sophisticated controls they are transmitted into the drivetrain and gearbox causing substantial design and reliability problems.

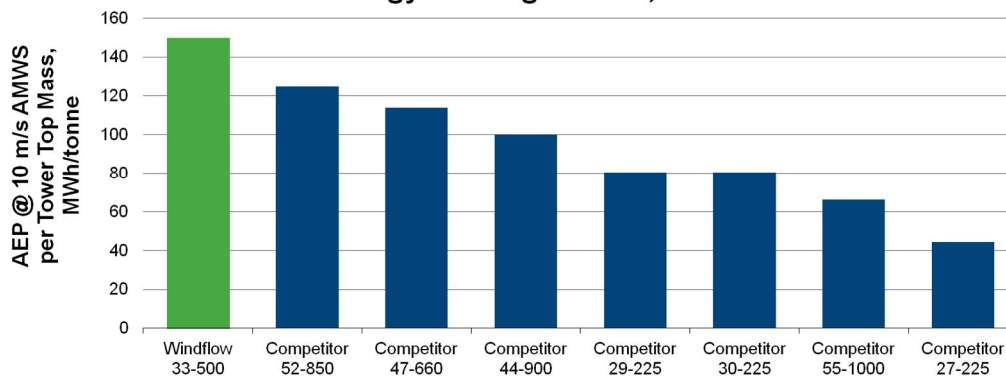
Two-bladed rotors lend themselves to the use of a teeter hinge, a well-tested and understood technology that passively relieves most of the imbalanced loads on the rotor. Loads simulation comparisons indicate a 50%+ reduction in main shaft bending fatigue loads for teetering two-bladed machines versus comparably-sized three-bladed machines. This translates into substantial reductions in weight and cost throughout the turbine.

Windflow extends this idea to incorporate pitch-teeter coupling into the design, which improves both energy capture and teeter stability during transients. These features are embodied in Windflow's proprietary **Teeter Control System™**.

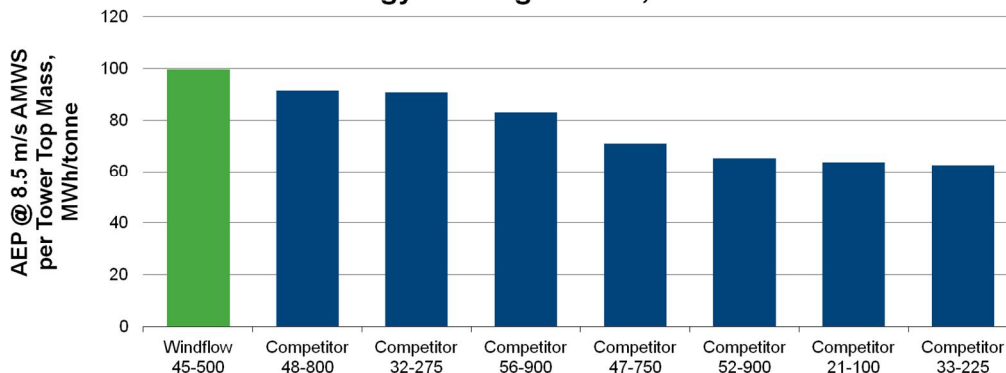


The success of this design philosophy is evident in Windflow products having the highest annual energy production (AEP, measured in MWh/year) per tower top mass (measured in tonnes) in their respective design classes. And since this is achieved through load reductions rather than through exotic materials, it translates into an extremely cost-effective design.

Energy-to-Weight Ratio, Class I Turbines



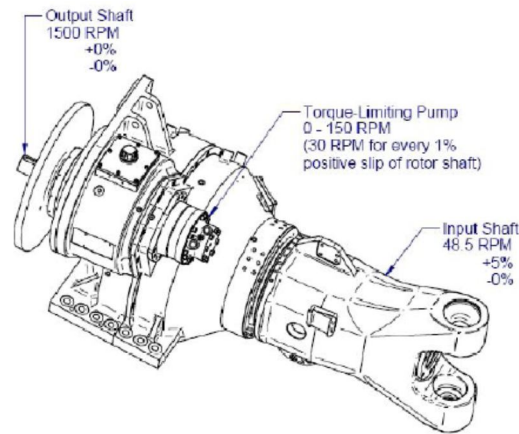
Energy-to-Weight Ratio, Class II Turbines



As the Teeter Control System™ provides a passive means of mitigating rotor imbalance loads, so does Windflow's patented Torque Limiting Gearbox™ (TLG) provide a passive mechanical means of removing torque transients from the drivetrain. The TLG provides near-instantaneous response to torque transients, whether induced by the wind or by electrical grid disturbances, thereby reducing torsional fatigue and impact loads throughout the drive-train. This results in a highly reliable, low maintenance turbine.

The TLG has two output shafts. The majority of the wind power captured by the rotor is transmitted through to the main output shaft, which drives a synchronous generator, synchronized to the grid at 1500/1800 RPM.

The second output shaft drives a low-inertia torque limiting pump. This pump energizes a proprietary hydraulic subsystem which manages any rapid fluctuations in the input wind power by a combination of storage and dissipation means.



The TLG protects the drive train from torsional impact and fatigue and enables the use of a synchronous generator directly on line. Synchronous generators eliminate the need for power electronic frequency conversion, saving both upfront and maintenance costs. They also enable abundant reactive power support for weak or unstable grids. This is a major advantage in the markets Windflow serves.

Windflow's proprietary **Low Variable Speed™** system enables the rotor of Windflow turbines to run 25% slower than the rated wind speed while maintaining the output shaft speed constant. This improves aerodynamic efficiency and turbine output at lower wind speeds, enables cut-in at lower wind speeds, and reduces blade tip noise in low wind conditions.

INTELLECTUAL PROPERTY

The intellectual property Windflow is offering for license includes:

- 600+ turbine component drawings
- 150+ drawings of special-purpose tooling
- 50+ procedure drawings for nacelle assembly and erection processes
- 20+ detailed specification documents
- Detailed factory commissioning and field commissioning procedures
- Operating manuals, maintenance manuals and various repair procedures
- Bladed software models of the turbines for mechanical loads analysis and performance simulations
- 4000+ pages of detailed calculations to achieve IEC Type Certification
- Comprehensive Type Testing reports for the Windflow 33-500
- PLC turbine control software
- Turbine and wind farm SCADA software
- Extensive team know-how in 2-bladed wind turbine design and control



THE TEAM

Windflow is led by CEO/Director Geoff Henderson, who has three decades of wind industry experience in Europe, North America and New Zealand.

Under his leadership, Windflow has developed a world class multi-disciplinary engineering team that collectively has more than 140 years of engineering experience, with over 70 years in wind turbine design, manufacturing and operation. The Windflow team can support licensees with a wide range of services, from initial technology transfer to ongoing design, programming and support.

EXPRESSIONS OF INTEREST

Windflow is seeking manufacturing licensees for its innovative, field-proven wind turbine designs and intellectual property in major markets globally. To register your interest, contact CEO/Director Geoff Henderson at geoff.henderson@windflow.co.nz



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